



Diversity and distribution of jumping plant-lice (Hemiptera: Psylloidea) along edges of Amazon–Cerrado transitional forests in Sorriso, Mato Grosso, Brazil

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Abstract. Little is known about the jumping plant-lice of Brazil from where seven families, 45 genera and 76 species have been previously reported, but estimates suggest that there may be as many as 1,000 species. This study reports 34 species of Psylloidea which were collected along the edges of Amazon–Cerrado natural transitional forests in the municipality of Sorriso, state of Mato Grosso, from August 2013 to July 2014. Of the species reported in this study only nine represent described taxa, two of which are reported for the first time from Mato Grosso.

Key words. Abundance; Brazilian Midwest; Sternorrhyncha

INTRODUCTION

Psylloids or jumping plant-lice are small phloem-feeding insects that are usually highly specific with respect to the plants on which they develop (BURCKHARDT et al. 2014). There are currently around 4,000 species described world-wide, but this is probably less than half of the existing number of species. This lack of knowledge is particularly serious in the Afrotropical and Neotropical regions. For Brazil, for example, BURCKHARDT & QUEIROZ (2012) list 73 named, valid species, with another 12 species added since (BURCKHARDT & QUEIROZ 2013; BURCKHARDT et al. 2013; MALENOVSKÝ et al. 2015; BURCKHARDT & QUEIROZ 2017). BURCKHARDT & QUEIROZ (2012) estimated that there may be as many as 1,000 species of Psylloidea in Brazil, the fifth largest country in the world with some of the most species-rich biomes. Among these are the Amazon forest and the Cerrado which are characterized by a high plant diversity (OLIVEIRA et al. 2008; MENDONÇA et al. 2008).

Mato Grosso, the third largest state of Brazil, contains three major biomes: the Amazonian, the Cerrado and the Pantanal. Potentially it has, therefore, also a species-rich psylloid fauna. However, at present only seven species have been recorded from this state (BURCKHARDT & QUEIROZ 2012, 2013; BURCK-

HARDT et al. 2013; MAZZARDO 2014; MAZZARDO et al. 2016): the two introduced eucalypt pests *Blastopsylla occidentalis* and *Glycaspis brimblecombei*, the three Fabaceae feeders *Euphalerus clitoriae*, *Isogonoceraia divergipennis* and *Macrocora beeryi*, the *Toona* pest *Mastigimas anjosi*, and the *Nectandra* psylloid *Limataphalara lautereri*.

To improve the apparent lack of knowledge, a survey of the psylloid fauna of the edges of Amazon–Cerrado native transitional forests was conducted in Sorriso, Mato Grosso, Brazil. Here we present a commented inventory of the species encountered during the dry and rainy seasons.

MATERIALS AND METHODS

The study was conducted in the Fazenda Irmãos Mazzardo, municipality of Sorriso, state of Mato Grosso, Brazil, located at km 15 of motorway MT 242 from Sorriso to Ipiranga do Norte ($12^{\circ}23'35.34''$ S, $055^{\circ}47'33.50''$ W) at 300–400 m above sea level (Figure 1). The climate is tropical rainy (Köppen AW type) with a distinct dry season (from April to September) and temperatures between 20–40 °C (annual average 26 °C). The average annual rainfall varies between 1800–2000 mm. The predominant soil type is dystrophic Oxisol with moderate and clayey dystrophic Dark-Red Latosol with moderate medium texture (SEPLAN 2011). The collections were made in wooded seasonal savanna vegetation with gallery forest and semideciduous forest with emergent canopy (SEMA 2014).

Samples were collected from August 2013 to July 2014 with a sweep net and an entomological aspirator into vials containing 70% ethanol. Sampling was carried out under the collecting permit number 13362 issued by IBAMA / SISBIO.

Voucher specimens are deposited in the Entomology Laboratory of the Biological Assets of Southern Amazon (ABAM), Federal University of Mato Grosso (UFMT), University Campus of Sinop, MT, Brazil [MRB] and in the Entomological Collections of the Naturhistorisches Museum, Basel, Switzerland [NHMB]. The vouchers in the former collection

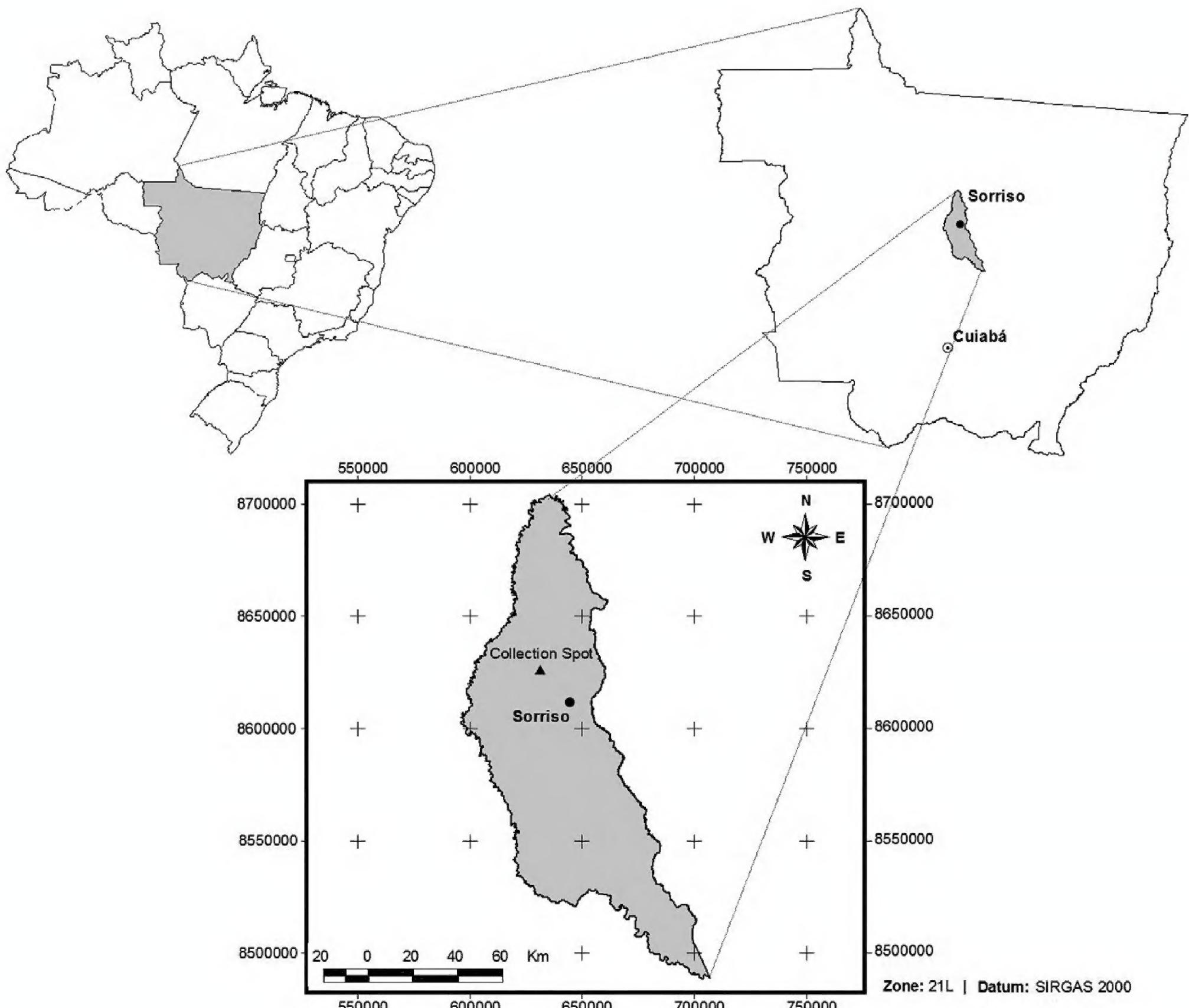


Figure 1. Map of study area in Sorriso, state of Mato Grosso, Brazil. ▲ = collection point.

correspond to the format ‘MRB_psy001’, those of the latter collection to ‘NHMB 00003022’.

The classification and nomenclature of Psylloidea follow BURCKHARDT & OUVRARD (2012) and BURCKHARDT & QUEIROZ (2012), respectively; the nomenclature of the plants is in accordance with *The Plant List* (2016). The psylloids were identified, apart from using the literature cited in the ‘Results’ section, by comparison with material in the psyllid collection of the NHMB.

RESULTS

During the study 34 species of seven families were found. Nine species represent described taxa of which two are recorded for the first time from Mato Grosso (*Phacosemoides sicki* and *Trioza tabebuiae*) (Table 1). The others have not yet been identified to species.

Here we present a detailed species list with information on the occurrence in Sorriso, the general distribution and host plants, as far as known, and comments, for some species.

List of taxa

Aphalaridae
Aphalarinae

Limataphalara lautereri Burckhardt & Queiroz, 2013

Figure 2a

Limataphalara lautereri BURCKHARDT & QUEIROZ (2013): 52

Material examined. Sorriso, vouchers NHMB 00002992, NHMB 00002993, NHMB 00003024, MRB_psy327. Very common in the rainy season but also present in the dry season.

Head lacking genal processes. Clypeus subspherical. Metacoxae with area beneath meracanthus strongly swollen; metatibiae with a crown of strongly sclerotized apical spurs. Male proctiger with long posterior processes. Parameres relatively slender with short thumb-like process in apical third of the fore margin and sclerotized apical margin; inner face in apical third of posterior half with tubercular microsculpture; dorsal margin with moderately long, spaced setae. Distal segment of aedeagus moderately thick with large apical hook and moderately long,

Table 1. List of psylloid species found in Sorriso, MT, Brazil during the dry and rainy seasons in 2013 and 2014 with numbers of collected males and females.

Taxon	Dry season 2013		Rainy season 2014		Dry season 2014	
	Male	Female	Male	Female	Male	Female
Aphalaridae						
Aphalarinae						
<i>Limataphalara lautereri</i>	3	6	83	87	0	6
Spondylaspidae						
<i>Blastopsylla occidentalis</i>	0	3	0	0	0	0
<i>Glycaspis brimblecombei</i>	5	8	0	0	1	0
Calophyidae						
Mastigimatinae						
<i>Mastigimas anjosi</i>	0	1	0	0	0	0
Liviidae						
Euphyllurinae						
<i>Tuthillia cf. cognata</i>	0	0	0	0	4	6
Phacopteronidae						
<i>Phacosemoides sicki</i>	0	0	0	1	8	7
Psyllidae						
Ciriacrinae						
<i>Isogonoceraia divergipennis</i>	2	4	0	0	4	6
Macrocorsinae						
<i>Euphalerus clitoriae</i>	1	3	0	0	1	0
<i>Macrocorsa beeryi</i>	10	16	4	8	1	10
Triozidae						
<i>Trioza tabebuiae</i>	0	1	0	0	0	0

sinuous sclerotized end tube of the ductus ejaculatorius, which bears a tubercle on its dorsal side. Female subgenital plate short, with shallow, narrow incision apically.

Distribution. Brazil: Pará and Mato Grosso (BURCKHARDT & QUEIROZ 2013).

Host plant. *Nectandra cuspidata* Nees & Mart. (Lauraceae) (BURCKHARDT & QUEIROZ 2013).

Spondylaspidae

Blastopsylla occidentalis Taylor, 1985

Figure 2b

Blastopsylla occidentalis TAYLOR (1985): 22 — BURCKHARDT & ELGUETA (2000): 57

Material examined. Sorriso, vouchers MRB_psy328. Only a few specimens in the dry season.

Head with genal processes shorter than vertex along midline, irregularly tapered. Antennae about as long as head width; segment 10 bearing a short truncate and a long curved seta. Forewing rounded apically. Metacoxae lacking meracanthus, angular posteriorly; metatibiae with 2+3 apical metatibial spurs; metabasitarsi with 1 outer sclerotized spur. Male proctiger two-segmented; basal portion bearing two lateral lobes, which are longer than distal segment. Parameres lamellar, curved backwards, bearing a row of 5–7 strongly sclerotized peg setae on the inner surface in apical half.

Distribution. Originating from Australia, introduced into Africa, Asia, Europe, New Zealand and, North and South America (Ouvrard 2017)—Brazil: Espírito Santo, Goiás, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Paraná, São Paulo, Tocantins (BURCKHARDT & QUEIROZ 2012; SILVA et al. 2013).

Host plants. *Eucalyptus* spp. (Myrtaceae) (BURCKHARDT & QUEIROZ 2012).

Glycaspis brimblecombei Moore, 1964

Figure 2c

Glycaspis brimblecombei MOORE (1964): 163 — BURCKHARDT et al. (2008): 85

Material examined. Sorriso, vouchers NHMB 00003055, MRB_psy329. Some specimens in the dry season.

Head with genal processes longer than vertex along midline, irregularly tapered. Antennae more than twice as long as head width; segment 10 bearing a short truncate and a long curved seta. Forewing angular apically. Metacoxae lacking meracanthus, angular posteriorly; metatibiae with 2+2 apical metatibial spurs; metabasitarsi with 2 outer sclerotized spur. Male proctiger two-segmented with short distal segment. Parameres angled in the basal third and subacute apically.

Distribution. Originating from Australia, introduced into Africa, North and South America, Asia and Europe (OUVRARD 2017)—Brazil: Bahia, Distrito Federal, Espírito Santo, Goiás, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pernambuco, Paraná, Rio Grande do Sul, Santa Catarina, São Paulo, Tocantins (BURCKHARDT & QUEIROZ 2012; SILVA et al. 2013).

Host plants. *Eucalyptus* spp. (Myrtaceae) (BURCKHARDT & QUEIROZ 2012).

Calophyidae

Mastigimatinae

Mastigimas anjosi Burckhardt et al., 2011

Figure 2d



Figure 2. Psyllid species found in Sorriso, MT, Brazil. **a.** *Limataphalara lautereri*. **b.** *Blastopsylla occidentalis*. **c.** *Glycaspis brimblecombei*. **d.** *Mastigimas anjosi*. **e.** *Tuthillia* cf. *cognata*. **f.** *Phacosemoides sicki*. **g.** *Isogonoceraia divergipennis*. **h.** *Trioza tabebuiae*. Photos by Dalva L. de Queiroz.

Mastigimas anjosi BURCKHARDT et al. (2011): 111 — BURCKHARDT et al. (2013): 3

Material examined. Sorriso, vouchers MRB_psy333. Only one specimen in the dry season.

Antennal segment 1 (scape) about 1.2 times as long as wide, segment 3 about twice as long as segment 4. Forewing widest in the apical third, broadly rounded apically; pterostigma relatively long and slender. Male proctiger slender. Parameres short, strongly widening towards apex; inner lobe about half as wide as outer lobe apically. Female proctiger with long and strongly upturned apical portion.

Distribution. Trinidad, Venezuela (BURCKHARDT et al. 2013) — Brazil: Minas Gerais, Mato Grosso, Paraná, Rio Grande do Sul, São Paulo (BURCKHARDT et al. 2011, 2013; BURCKHARDT & QUEIROZ 2012).

Host plants. Native hosts are *Cedrela fissilis* Vell. and perhaps *C. odorata* L. (Meliaceae) (BURCKHARDT et al. 2013). In plantations in Brazil, *M. anjosi* develops also on *Toona ciliata* M. Roem. (Meliaceae) on which it can inflict severe damage.

Liviidae
Euphyllurinae

Tuthillia cf. cognata Hodkinson, Brown & Burckhardt, 1986

Figure 2e

Tuthillia cognata HODKINSON et al. (1986): 54, 58

Material examined. Sorriso, vouchers NHMB 00003005, NHMB 00003006, MRB_psy336. Some specimens during the dry season.

Head directed in longitudinal body axis, bearing long genal processes, which are longer than vertex along mid-line and pointed apically. Forewing elongate, apex angular. Metatibiae with an open crown of sclerotized apical spurs. Male proctiger with flattened posterior lobes; subgenital plate elongate. Inner surface of parameres, in basal third, proximal to thick medium long setae, with a group of thinner and longer setae. Dorsal margin of female proctiger concave; upturned apex short; circumanal ring relatively long (HODKINSON et al. 1986).

Distribution. Peru (Burckhardt and Couturier 1988) — Brazil: Amazonas (BURCKHARDT & QUEIROZ 2012) and newly recorded from Mato Grosso.

Host plant. *Myrciaria dubia* (Kunth) McVaugh (Myrtaceae) (BURCKHARDT & QUEIROZ 2012). Immatures of *T. cognata* induce blister galls on the leaves of the host and are pests in plantations (BARBOSA et al. 2004).

Comments. The material from Mato Grosso differs from specimens from Peru and Amazonas in the shorter antennae, the antennal segment 3 which is longer rather than shorter than segment 8, and the slightly different forewing pattern. The series from Mato Grosso represents probably an undescribed species but more material is required to interpret these morphological differences.

Phacopteronidae

Phacosemoides sicki Costa Lima & Guitton, 1962

Figure 2f

Phacosemoides sicki COSTA LIMA & GUITTON (1962): 221

Material examined. Sorriso, vouchers NHMB 00002999, NHMB 00003000, NHMB 00003001, NHMB 00003002, NHMB 00003002, MRB_psy342. Some specimens mostly in the dry season.

Head bearing conical genal processes. Forewing lacking pterostigma, with veins Rs and M_{1+2} touching in one point. Metatibiae with prominent genual spine. Metacoxae bearing a tubercle on the outer side. Male subgenital plate subglobular; paramere sickle-shaped.

Distribution. Brazil: Pará (BURCKHARDT & QUEIROZ 2012) and newly recorded from Mato Grosso.

Host plant. Unknown

Comments. This is the first time that *Phacosemoides sicki* has been collected after its description more than 50 years ago. This documents well the poor state of knowledge on Brazilian psylloids.

Psyllidae
Ciriacreminae

Isogonoceraia divergipennis White & Hodkinson, 1980

Figure 2g

Isogonoceraia divergipennis WHITE & HODKINSON (1980): 81

Material examined. Sorriso, vouchers MRB_psy345. Some specimens during the dry season.

Head strongly deflexed from longitudinal body axis, with conical, medially contiguous genal processes. Antennae 1.5–1.9 times as long as head width, segment 3 shorter than either of segments 7 to 8, respectively. Forewing expanded and broadly rounded apically, broadest in apical third. Male proctiger subglobular; parameres about as long as proctiger, gradually narrowed to simple apex, which is bent anteriorly; distal portion of aedeagus very short and massive. Female proctiger cuneate; subgenital plate short, truncate apically.

Distribution. Brazil: Bahia, Minas Gerais, Paraná, São Paulo (BURCKHARDT & QUEIROZ 2012) and Mato Grosso (MAZZARDO 2014).

Host plant. *Caesalpinia pluviosa* DC. (Fabaceae) (BURCKHARDT & QUEIROZ 2012).

Macrocosmiae

Euphalerus clitoriae Burckhardt & Guajará, 2000

Euphalerus clitoriae BURCKHARDT & GUAJARÁ (2000): 326.

Material examined. Sorriso, vouchers NHMB 00003040, MRB_psy351. Few specimens in the dry season.

Head and thorax covered in dark spots. Genal processes longer than vertex along mid-line, conical, subacute apically. Antennae about twice as long as head width, segment 3 longer than segment 8. Forewing with pterostigma moderately long, 0.5 times as long as vein Rs. Parameres, in profile, with both an anterior and posterior lobe, inner surface with a group of strongly sclerotized peg setae basally; distal segment of aedeagus hook-shaped. Female terminalia cuneate.

Distribution. Brazil: Alagoas, Bahia, Minas Gerais, Mato Grosso, Pernambuco, Rio de Janeiro (BURCKHARDT & QUEIROZ 2012).

Host plant. *Clitoria fairchildiana* R. A. Howard (Fabaceae) (BURCKHARDT & QUEIROZ 2012).

Macrocorsa beeryi (Caldwell, 1944)

Psyllia beeryi CALDWELL (1944): 339

Limbopsylla beeryi – BROWN & HODKINSON (1988): 139

Macrocorsa beeryi – BURCKHARDT & QUEIROZ (2012): 39

Material examined. Sorriso, vouchers NHMB 00003041, MRB_psy352. Common mostly during the rainy season.

Head with vertex subtrapezoidal; genal processes broad, margins convex. Antennae more than three times as long as head width; segment 3 shorter than any of segments 7 or 8. Metatibiae bearing distinct genual spine and four grouped apical sclerotized spurs. Forewings oblong-oval, broadest in the middle; cell cu_2 large. Male proctiger tubular, simple; parameres long and narrow, evenly tapering to apex; distal portion of aedeagus with large, angular apical expansion. Female terminalia short; proctiger truncate apically.

Distribution. Panama (BROWN & HODKINSON 1988). Brazil: Maranhão, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará (BURCKHARDT & QUEIROZ 2012).

Host plant. *Hymenaea courbaril* L. (Fabaceae) (BURCKHARDT & QUEIROZ 2012).

Triozaidae

Trioza tabebuiae Burckhardt & Santana, 2001

Trioza tabebuiae Burckhardt & Santana in SANTANA & BURCKHARDT (2001): 542

Material examined. Sorriso, vouchers MRB_psy357. A single specimen in the dry season.

Head with genal processes about half as long as vertex midline, subacute. Antennae about 1.4 times head width; segment 10 with one seta subacute, about as long as segment, and second seta truncate, about a quarter as long as segment. Forewings oblong-oval, widest near the middle, fore margin strongly, hind margin weakly curved. Metatibiae lacking sclerotized apical spurs.

Distribution. Brazil: Paraná (BURCKHARDT & QUEIROZ 2012) and newly recorded from Mato Grosso.

Host plants. *Handroanthus* spp. (Bignoniaceae) (BURCKHARDT & QUEIROZ 2012). The immatures induce leave curling. The species is sometimes a pest (SANTANA & BURCKHARDT 2001).

DISCUSSION

Two species (*Phacosemoides sicki* and *Trioza tabebuiae*) of psylloid are reported for the first time from Mato Grosso. All seven species previously recorded from that state were also found during this study.

LEWINSOHN & PRADO (2005) stated that there is a big problem in Brazil concerning the lack of knowledge on the biodi-

versity of most groups, and RAFAEL et al. (2009) concluded that the problem is due to the combination of enormous species richness on one hand and the small number of taxonomists able to recognize and describe this wealth of species.

The plant diversity is, to a certain extent, an indicator of the number of psylloids potentially occurring in a particular habitat. PERCY (2011) concluded in a study on the psylloids of the Macaronesian Islands that the psylloid diversity is notably influenced and apparently restricted by the diversity of host plants. LEWINSOHN et al. (2001) reported that among the habitats that provide refuge for insects are the tropical forests that stand out for having high biodiversity due to numerous ecological niches, the high level of stratification and complexity of relationships within the food chain and between components of different communities.

Brazil is known for its immense biodiversity but less than 10% of its species are known (LEWINSOHN & PRADO 2005). This is also true for Psylloidea where less than 100 species have been reported from Brazil, but estimates suggest that there may be more than 1,000 (BURCKHARDT & QUEIROZ 2012). The present study helps to increase the knowledge on the superfamily Psylloidea in Mato Grosso and Brazil. The lack of knowledge on the species richness and composition is a major obstacle in understanding and managing the huge biodiversity of the country.

ACKNOWLEDGEMENTS

We thank Dra. Erika Pessoa Japhyassu Britto and two anonymous reviewers for useful suggestions on the manuscript.

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Authors' contributions: TM, collected the material and analysed the data, TM, MRB, DLQ and DB wrote the text, and DB identified most of the material.

Received: 21 June 2016

Accepted: 3 March 2017

Academic editor: Márcio Eduardo Felix